Beijer Servo Drives, BSD – Start Up Manual

KI00354 2014-02

1 Function and area of use

This document describes the basic functionality of the Beijer Servo Drives – BSD – series, covering installation, general specifications and basic parameters for the BSD drives, motors and accessories.

2 About this Start Up document

In addition to this manual you will need the document “iX TxB SoftMotion Basic setting”, KI00353, with instructions of how to implement a solution with an iX SoftMotion project and a CODESYS application controlling eight BSD servo drives.

The full documentation of the BSD products can be found in the BSD L7N User Manual Eng, with an in depth descriptions of all functionality.

All documents can be downloaded from www.beijer.se/no/dk/fi.

3 Main features

Compact and easy to use multi purpose servo for single or multi axis applications. Very high performance by high efficieny motors and drives combined with motion libraries in CODESYS for advanced positioning.

Encoder: 19 bit (524 288 bits/revolution) single turn or multi turn (with backup battery).
Power supply: One or three phase 230VAC.
Control terminals 24VDC source or sink.
Brake transistor: Built in
Internal brake resistor: Built in
Mechanical interface: Keyed shaft delivered with loose key
Overload performance: 300% peak torque
Communication: EtherCAT, (programmed using CODESYS SoftMotion).
Safety: Safe Torque Off (STO) functionality via two 24VDC inputs and a supervision output.

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4 Safety precautions

Safety precautions are categorized as either Warnings or Cautions, depending on the severity of the precaution.

Precautions	Definition
⚠ Warnings	Failure to comply with these guidelines may cause serious injury or death.
⚠ Caution	Failure to comply with these guidelines may cause personal injury or property damage.

- Precautions listed as Cautions may also result in serious injury.

■ Electric Safety Precautions

⚠ Warning

- Before wiring or inspecting the device, turn off the power, wait 15 minutes, ensure that the charge lamp is off, and then check the voltage.
- Ground both the servo drive and the servo motor.
- Only specially trained technicians may perform wiring on this product.
- Install both the servo drive and servo motor before performing any wiring.
- Do not operate the device with wet hands.
- Do not open the servo drive cover during operation.
- Do not operate the device with the servo drive cover removed.
- Even if the power is off, do not remove the servo drive cover.

■ Installation Precautions

⚠ Caution

- Install the product with the correct orientation.
- Do not drop the product or expose it to hard impact.
- Install this product in a location that is free from water, corrosive gas, combustible gas, or flammable materials.
- Install this product in a location capable of supporting the weight of this product.
- Do not stand on the product or place heavy objects on top of it.
- Always maintain the specified spacing when installing the servo drive.
- Ensure that there are no conductive or flammable debris inside the servo drive or the servo motor.
- Firmly attach the servo motor to the machine.
- Install the servo motor with a correctly oriented decelerator.
- Do not touch the rotating unit of the servo motor during operation.
- Do not apply excessive force when connecting the couplings to the servo motor shaft.
- Do not place loads on the servo motor shaft that exceed the specified amount.

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Repair/Inspection Precautions

⚠ Caution

- Before wiring or inspecting the device, turn off the power, wait 15 minutes, ensure that the CHARGE lamp is off, and then check the voltage. Enough voltage may remain in the condenser after the power is off to cause an electric shock.
- Only authorized personnel may repair and inspect the device or replace its parts.
- Do not modify this device in any way.

EEPROM Lifespan

⚠ Caution

- The EEPROM is rewritable up to 1 million times for the purpose of recording parameter settings and other information. The servo drive may malfunction if the total number of the following tasks exceeds 1 million, depending on the lifespan of the EEPROM.
  - EEPROM recording as a result of parameter changes
  - EEPROM recording as a result of an alarm

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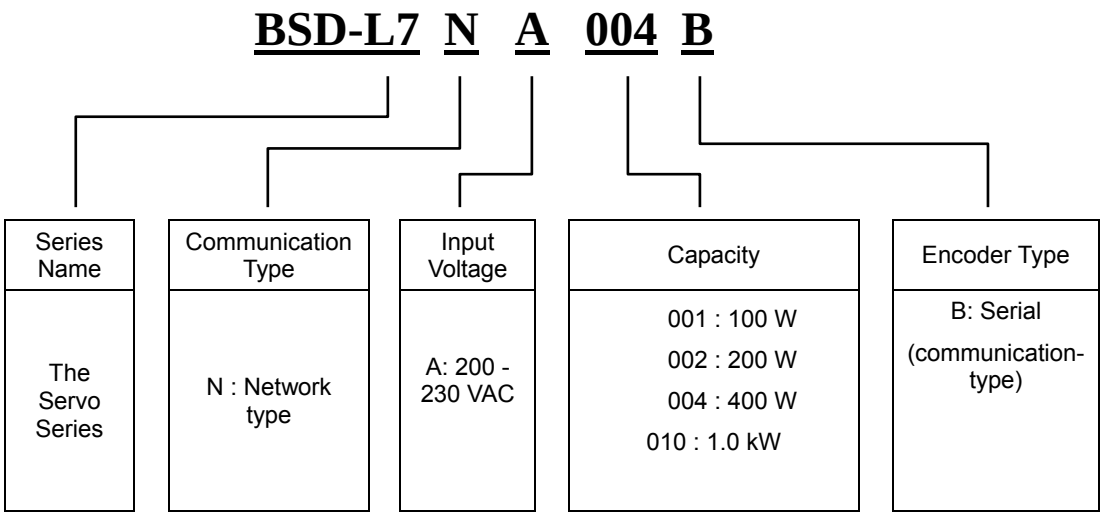
5 Product overview

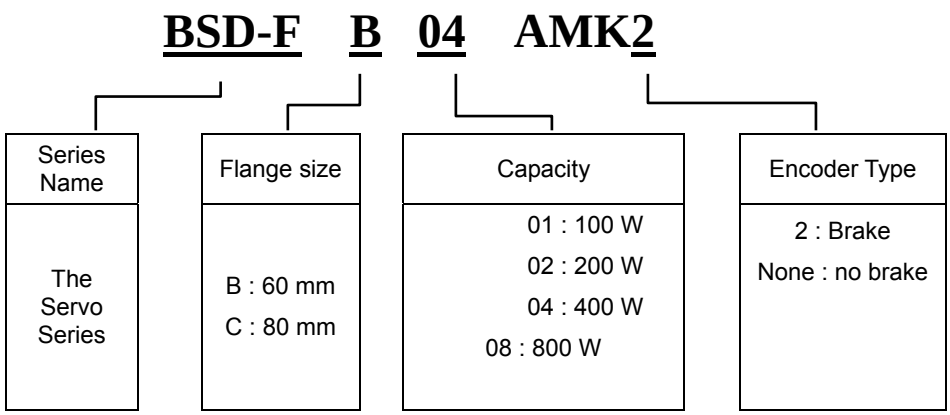
The BSD L7-series is a cost effective general purpose servo that can be used in very demanding applications. It is intended for EtherCAT applications controlled by CODESYS SoftMotion. The BSD products provide a solution designed for “ease of use” and flexibility in every step of the process:

- Easy to install with compact dimensions and pre made connectors
- Easy to setup in a network with standard patch cables
- Easy to reach a very high network performance without any special settings
- A network can be combined with all types of products supporting the EtherCAT standard:
  - Distributed I/O
  - Inverters
  - External encoders
  - etc… Only one bus needed for the whole project
- Easy to program by using debugged CODESYS templates from Beijer Electronics
- Easy to handle advanced functionality thanks to extended libraries
- Easy to tune and troubleshoot via advanced trace functions in CODESYS

5.1 Servo drive ordering key



5.2 Servo motor ordering key



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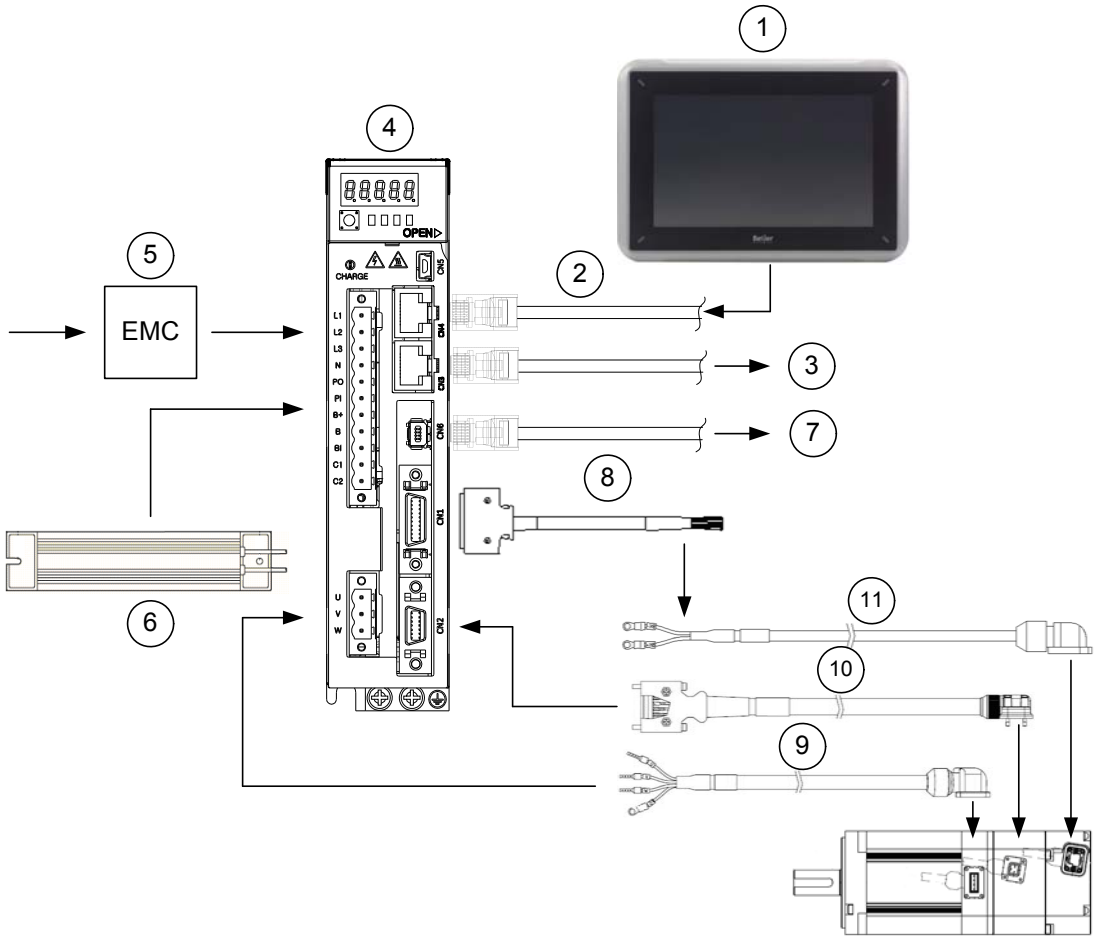
5.3 Components selection chart

A typical application contains the following set of products. See the *Specifications* section regarding details of each product.



1. iX TxB Operator panel acting as an EtherCAT Master.
2. CN4, Ethernet patch cable for EtherCAT INPUT.
3. CN3, Ethernet patch cable for EtherCAT OUTPUT to next node.
4. BSD servo drive, BSD-L7NA-□□□B, see Specifications servo drives.
5. EMC-filter, BSD-TB6-B□□□…, see Specifications EMC-filters.
6. External brake resistor, BSD-□□□R□□□E, see Specifications brake resistors.
7. CN6, Safety, BSD-STO□□A, see Safety cables. [1)]
8. CN1, I/O-cable, BSD-CN□□□A, see CN1 I/O-cables.
9. Motor cable, BSD-PF□□FS, Motor power and brake cables.
10. Encoder cable, BSD-EF□□ES□, see Encoder cables.
11. Brake cable, BSD-BF□□QS, see Motor power and brake cables.
12. BSD servo motor, BSD-F□□□AMK□, see Specifications servo motors.

1) If the safety functionality is not used the CN6 contact must be blinded with an APCS-CN6J-connector, see Optional connectors and accessories.

Note: These articles differs between XXXXXXXXX.

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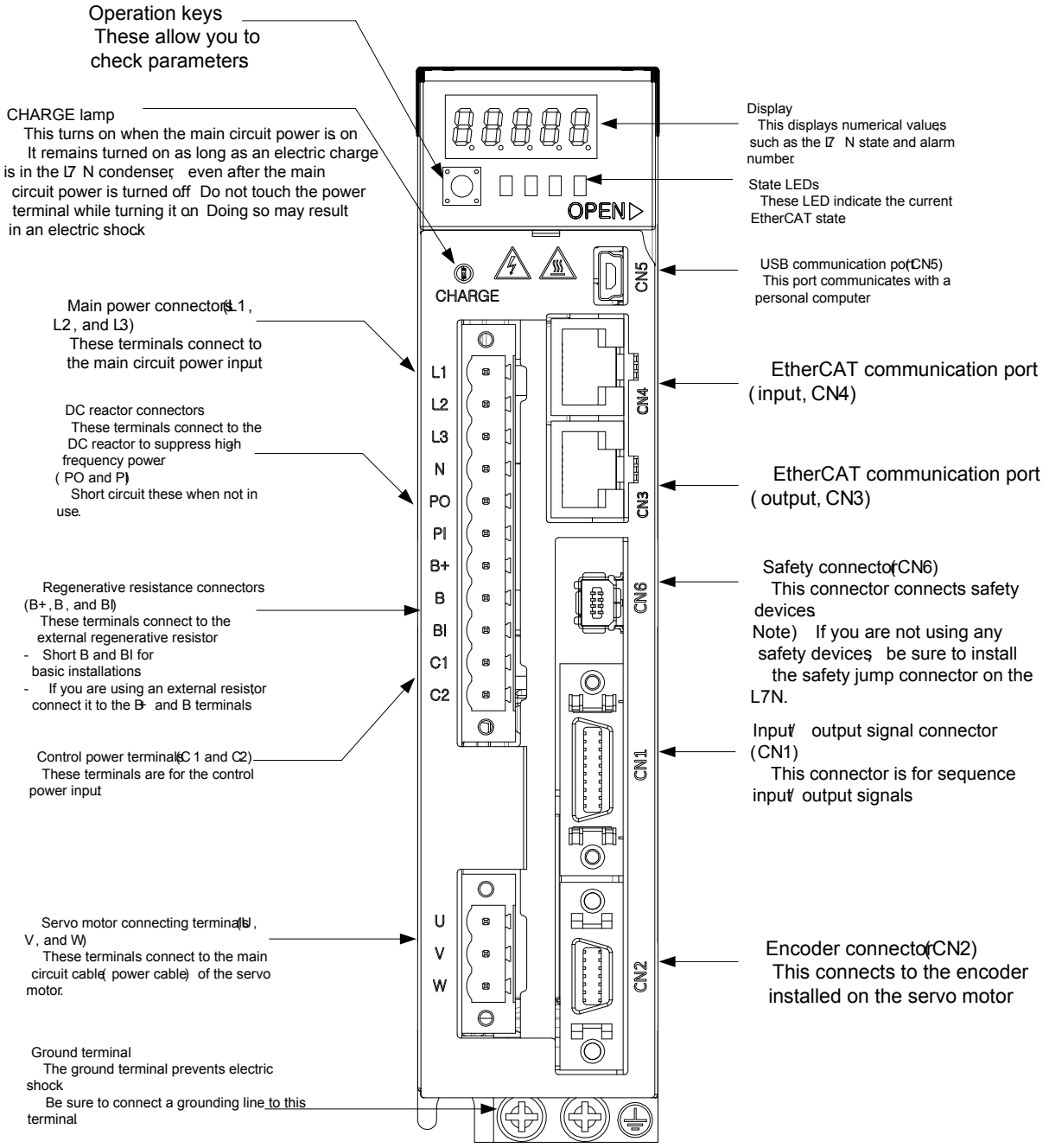
5.4 Servo drive connectors and functions


Operation keys
These allow you to check parameters
CHARGE lamp
This turns on when the main circuit power is on. It remains turned on as long as an electric charge is in the L7N condenser, even after the main circuit power is turned off. Do not touch the power terminal while turning it on. Doing so may result in an electric shock.
Main power connectors (L1, L2, and L3)
These terminals connect to the main circuit power input.
DC reactor connectors
These terminals connect to the DC reactor to suppress high frequency power (PO and P1).
Short circuit these when not in use.
Regenerative resistance connectors (B+, B, and BI)
These terminals connect to the external regenerative resistor.
- Short B and BI for basic installations.
- If you are using an external resistor, connect it to the B+ and B terminals.
Control power terminals (C1 and C2)
These terminals are for the control power input.
Servo motor connecting terminals (U, V, and W)
These terminals connect to the main circuit cable (power cable) of the servo motor.
Ground terminal
The ground terminal prevents electric shock.
Be sure to connect a grounding line to this terminal.
Display
This displays numerical values such as the L7N state and alarm number.
State LEDs
These LED indicate the current EtherCAT state.
USB communication port (CN5)
This port communicates with a personal computer.
EtherCAT communication port (input, CN4)
EtherCAT communication port (output, CN3)
Safety connector (CN6)
This connector connects safety devices.
Note) If you are not using any safety devices, be sure to install the safety jump connector on the L7N.
Input/output signal connector (CN1)
This connector is for sequence input/output signals.
Encoder connector (CN2)
This connects to the encoder installed on the servo motor.
OPEN
CHARGE
L1
L2
L3
N
PO
P1
B+
B
BI
C1
C2
U
V
W
CN5
CN4
CN3
CN6
CN1
CN2

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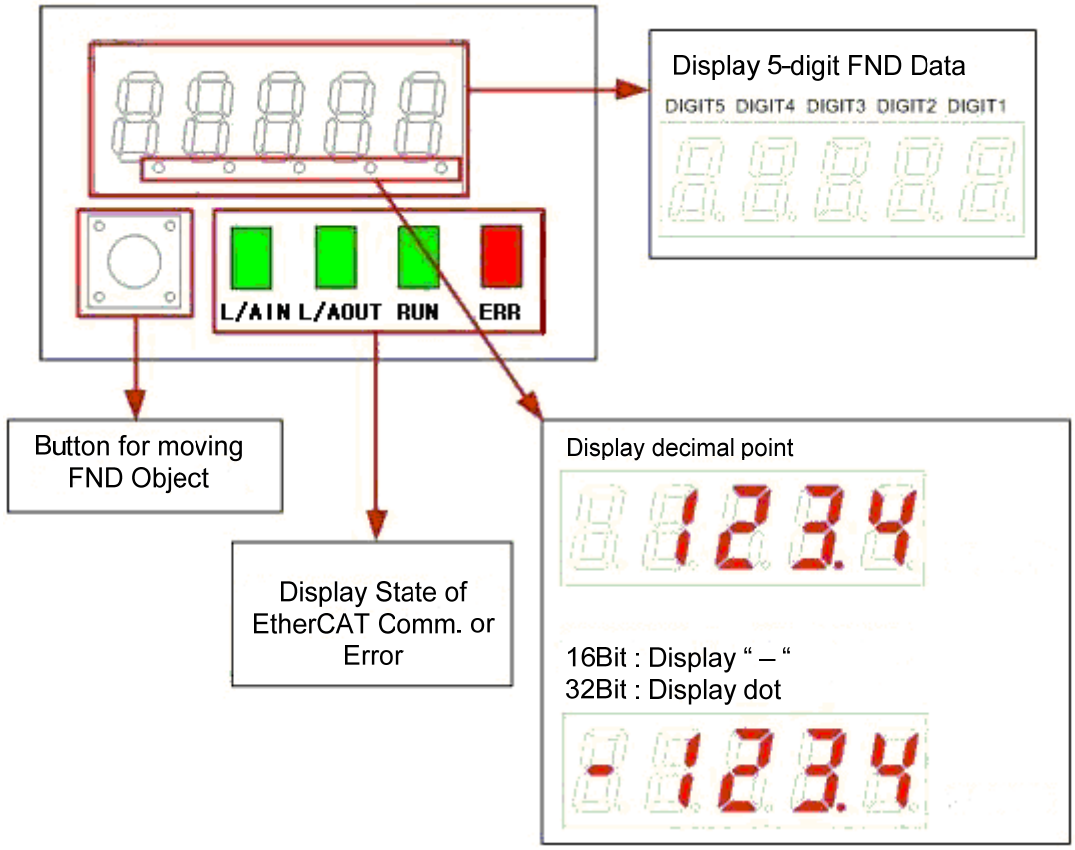
5.5 Keypad handling

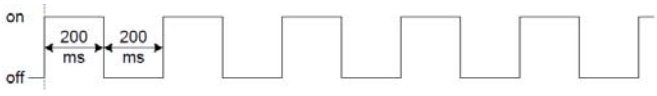

Display 5-digit FND Data
DIGIT5 DIGIT4 DIGIT3 DIGIT2 DIGIT1
L/AIN L/AOUT RUN ERR
Button for moving FND Object
Display State of EtherCAT Comm. or Error
Display decimal point
16Bit : Display " – "
32Bit : Display dot

5.5.1 Keypad LED states

The LEDs on the operating panel of the L7N drive indicates EtherCAT communication and error statuses.

■ L/A IN and L/A OUT (Link Activity) LEDs

The L/A IN LED and L/A OUT LEDs indicate the status of the CN4 and CN3 communication ports respectively. The following table outlines what each LED state indicates.

Link/Activity LED	Description
Off	Not connected for communication.
Flickering	Connected, and communication is enabled. 
On	Connected, but communication is disabled.

■ RUN LED

Indicates the status of the L7N in the EtherCAT State Machine.

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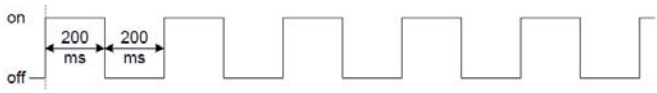
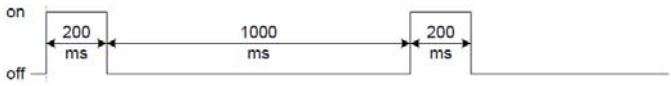
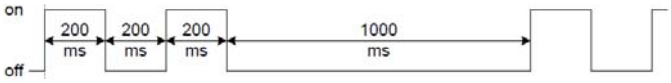
RUN LED	Description
Off	The L7N is in the INIT state.
Blinking	The L7N is in the Pre-Operational state. 
Single Flash	The L7N is in the Safe-Operational state.
On	The L7N is in the Operational state.

■ ERR (Error) LED

The ERR LED indicates the EtherCAT communication status. The following table outlines what each LED state indicates.

ERROR LED	Description
Off	EtherCAT communication is normal.
Flickering	A booting error occurred.
Blinking	The object setup command received from the EtherCAT master cannot be performed in the current state.
Single Flash	The state has changed without a command from the EtherCAT master due to a L7N drive sync error. 
Double Flash	A watchdog error occurred during EtherCAT communication. 
On	A serious problem occurred in the internal communication of the L7N drive.

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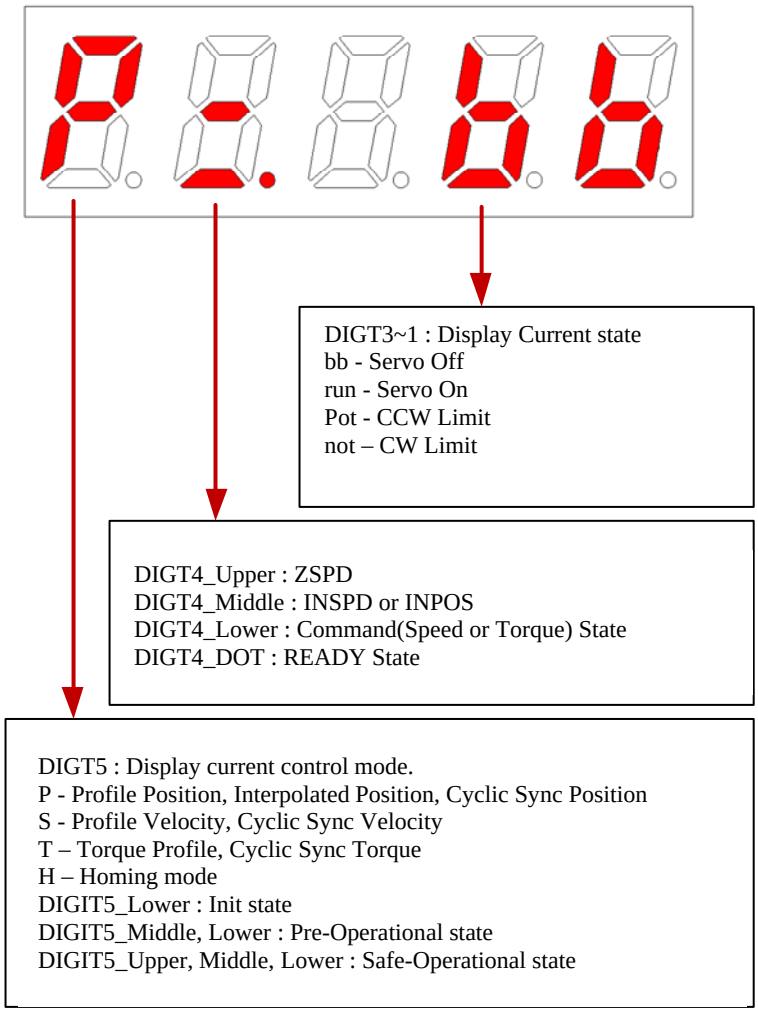
5.6 Reading drive status from keypad


DIGT3~1 : Display Current state
bb - Servo Off
run - Servo On
Pot - CCW Limit
not – CW Limit
DIGT4_Upper : ZSPD
DIGT4_Middle : INSPD or INPOS
DIGT4_Lower : Command(Speed or Torque) State
DIGT4_DOT : READY State
DIGT5 : Display current control mode.
P - Profile Position, Interpolated Position, Cyclic Sync Position
S - Profile Velocity, Cyclic Sync Velocity
T – Torque Profile, Cyclic Sync Torque
H – Homing mode
DIGIT5_Lower : Init state
DIGIT5_Middle, Lower : Pre-Operational state
DIGIT5_Upper, Middle, Lower : Safe-Operational state

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5.6.1 Keypad status table

Display of DIGT5	Function	Note
	Disconnect STO Connector.	
	Init state.	
	Pre-Op state.	
	Safe-Op state.	
	Servo OFF state in PP, IP or CSP Mode.	
	Servo ON state in PP, IP or CSP Mode.	
	CCW Limit state in PP, IP or CSP Mode.	
	CW Limit state in PP, IP or CSP Mode.	
	Servo OFF state in PV or CSV Mode.	
	Servo ON state in PV or CSV Mode.	
	CCW Limit state in PV or CSV Mode.	
	CW Limit state in PV or CSV Mode.	
	Servo OFF state in TQ or CST Mode.	
	Servo ON state in TQ or CST Mode.	
	CCW Limit state in TQ or CST Mode.	
	CW Limit state in TQ or CST Mode.	
	Servo OFF state in Homing Mode.	
	Servo ON state in Homing Mode.	
	CCW Limit state in Homing Mode.	
	CW Limit state in Homing Mode.	

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6 Selecting a servo system, general guidelines

In order for the servo motor to work well it must be selected according to the requirements of the specific application. The key parameters are the resulting motor torque, speed and inertia ratio. Other aspects are the positioning needs or the handling of mechanical or personal risks. This chapter aims to give a brief overview of the selection process. The actual parameter settings can be found in the section Basic parameters and initial setup. Contact Beijer Electronics Drive Systems for a calculation of the needed motor in the specific application, or for any advice regarding other drive related questions.

6.1.1 When to use a servo motor

All BSD servo motors are fully enclosed, self cooled synchronous motors with a built in high resolution encoder and a permanently magnetized rotor. This results in a very high efficiency and energy density that makes a servo motor very compact, well below half the size of a comparable standard induction motor. The absence of a mechanical fan makes the servo motor ideal for applications requiring high protection or hygiene restrictions. The PM-rotor in combination with encoder feedback offers the rated torque curve from standstill up to the rated speed. The speed range is wide since the servo motor can be manufactured for a custom voltage and frequency supplied by its companion servo drive.

The drawbacks are the price, the need for a servo drive (a synchronous motor can not be connected or started directly from the grid) and the lack of standardization. A servo motor can rarely be replaced with a motor from another manufacturer - without a mechanical adapter put in between - since the shaft or motor flange will most probably not fit.

6.1.2 Torque and speed

A PM-motor can operate continuously at its rated torque from stand still up to at least the rated speed. The motor will work as well at 30 rpm as on 3000 rpm. This gives a great flexibility when selecting mechanical gearings.

The motors can generate a peak torque of approximately three times the rated torque, although only for a few seconds and in combination with a period of low torque or rest. Any waiting time between movements is an important factor when designing high performance applications.

Note that the available torque will drop when the motor is running above its rated speed. At the double rated speed the motor will be able to generate about 50% of its rated torque.

A BSD servo motor has a wide speed range between 0 – 5000 rpm. Normally it is not a problem to run the motor above its rated speed, even for longer durations as long as the motor torque is kept low. However the life length of the bearings will be shortened.

A standard induction motor – in comparison – must operate at or close to its rated speed otherwise the air flow from the built in cooling fan will be too low and the motor will overheat. In addition the torque at double speed is often less than 30% of the rated torque.

6.1.3 Inertia ratio

The inertia ratio defines the relationship of the “fly wheel” properties between the motor and the load. The ideal value is a 1:1 ratio but most motors can handle a load with an inertia 10 – 20 times higher than the motor inertia.

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If the inertia ratio is too high the motor will not be able to control the load and the result will be overshooting and/or overload alarms, even if the torque and speed demands are well below the rated values. The easiest way to achieve a good inertia ratio for larger loads is to use a gearbox.

6.2 Selecting a motor with or without brake

All BSD motors can be ordered with or without a spring loaded mechanical brake. The brake is intended to hold the load at a fixed position when the servo drive is not operating. The brake can not be used for any kind of active braking. Furthermore it can not be used for any safety functionality.

The brake is operated with a 24VDC relay built into the motor. The relay must be activated for the brake to release.

Note that the motor is normally stronger than the brake. Running the motor with an activated brake will damage the brake permanently. Make sure that the brake relay is controlled in a correct way, using the BRAKE-terminals on the CN1-connector.

Note that a separate cable is needed to control the brake, see Motor power and brake cables.

6.3 Selecting incremental or absolute encoder

All BSD motors are equipped with a 19 bit absolute encoder (524 288 counts per motor turn). The encoder can be used as incremental or absolute depending on the selected type and encoder cable.

An incremental encoder cable will result in a cleared encoder value if the servo drive control power (C1, C2) is turned off. Use this type of cable in applications where a reference point is not needed or if a recalibration is easily made, or needed for other reasons, for example slippage.

An absolute encoder cable will maintain the encoder value after a power off. This done with a backup battery mounted on the cable. An application with an absolute encoder only needs to be calibrated once and will keep its position as long as the encoder power supply is maintained. The calibration can be done with or without a home sensor.

Applications with any risk of slippage might need a second external encoder. Contact Beijer Electronics for advice in these cases.

6.3.1 Encoder battery warning

When the battery life length is about to end it will trigger a warning W-02 (LOW BATT), but the system will continue to run. The warning must be monitored by the user program. When the battery is dead or faulty the drive will trigger the alarm AL-35 (Low voltage error) and the encoder value is lost (if the control power is turned off). Replace the battery and activate a home sequence.

Although the battery is only needed when the servo drive control power is turned off it is not possible to run without a working battery installed, unless the absolute functionality is turned off.

6.3.2 Battery replacement

The absolute encoder battery is installed in a case fastened on the encoder cable. Before replacing the battery the servo drive should be turned off. An internal capacitor will keep the encoder value for a few hours. Remove the old battery and replace it with a new.

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The expected life length of the battery depends on how long the servo drive control power is turned off. The life length can be estimated roughly to between one or three years. The battery cannot be charged.

6.4 Soft- and hardware limits

Many applications need some kind of position limit to prevent unallowed movements. A hard- or software limit will define the highest (positive) and lowest (negative) allowed position. Hardware limits are connected to the control signal inputs P-OT and N-OT and cannot be changed dynamically. In opposite a software limit is defined by the program and can be turned on and off at any time during operation as well as having its position changed, but at the cost of a somewhat lower reliability. The application specifications decide if hard- and/or software limits are needed.

When a hard- or software limit is reached the motor will stop and the drive will give an alarm. After the alarm is reset the motor is only allowed to move in the opposite direction. Ideally the limits should be set so that the brake distance of the motor will allow it to stop if reaching the limit at maximum speed, without causing any damage. If using hardware limits the sensors should be installed so the motor cannot reach the “wrong side” of the end limit.

6.5 Selecting the home position and calibration method

A calibration or *homing* defines a reference position for the servo. When a calibration is done the encoder is set to a user defined value, normally zero. All absolute movements will be made according to this position.

Depending on the calibration method a calibration can be made with or without a home sensor. The easiest calibration method for systems without any risk of slippage is to calibrate once without a sensor. This is done by moving the motor to the desired position and then issuing a calibration command. The most important concern with this method is to mark or document the home position so the calibration can be repeated in the future, if needed.

A home sensor can be used if there is a risk for the position to slip or to allow the home position to be adjusted by simply moving the sensor.

A homing method with a physical sensor normally involves a sequence to search for the sensor. Decide the positive movement direction and then mount the home sensor close to lower end limit. This will speed of the process since it is possible to always start the sensor search in negative direction, and will probably allow the home position to be set to or close to zero.

6.6 Setting the electronic gearbox

The purpose of the electronic gearbox is to hide the encoder resolution and mechanical design, so that the programmer can code all positions in the program with the unit and precision used in the application. This makes the program easy to read and if the encoder or mechanical solution is changed this can be handled by changing one single setting; the *electronic gearbox*.

A BSD servo motor has a resolution of 19 bits or 524 288 counts per turn. If the motor is mounted directly to a ballscrew with a mechanical movement of 10 mm per turn the electronic gearbox can be scaled as:

(encoder counts for the movement / movement in user units):

524 288 / 10

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This will cause all program positions to be multiplied by the electronic gearing. Moving to 20 mm would mean:

20 * (524288 / 10) = 1 048 576 which is equal to two motor turns (2 x 524 288).

Two turns on the motor (= ballscrew) gives: 2 x 10 = 20 mm, so the scaling above is correct.

This works fine except that the position variable used in the program is an integer so it is not possible to set any value with a higher precision. If the target position is 13.5mm the user would have to choose between moving to 13 or 14 mm. 13.5 can simply not be entered.

To solve this the electronic gearbox must be set up with at least the precision needed in the specific application or better. If the user need is a precision of 0.01 mm (10 µm) the electronic gearbox could be defined as:

524 288 / 10000 (= 10000 µm)

The electronic gearbox will have a precision of 1µm. All program position values will be given in µm. A movement to 13.5 mm should be entered as 13500 (13500 µm).

6.6.1 Manual calculation of the electronic gearbox

The best way to define the gearbox is to enter the exact values from the mechanical specifications: gearing, ballscrew pitch, drive wheel diameter etc. If these values are unknown it is possible to do a manual calculation by moving the motor a known distance and reading the number of motor counts.

To do this begin by setting the electronic gearbox to: 524 288 / 524 288. This will give an application resolution equal to the encoder resolution. Download the settings and make sure that the change takes effect. Mark the mechanical position and note the current encoder value. Move the motor to a second position, the further away the better. Make a new mark and measure the distance between the two marks as accurate as possible. Read the new encoder value and calculate the absolute difference between the two encoder values.

Assume that the servo motor has moved 810 mm and that the encoder difference is 31296385 counts. Since every turn adds 524288 counts the motor has rotated: 31296385 / 524288 = 59.69 turns. This means that the mechanical movement per servo motor turn is: 810 / 59.69 = 13.57 mm / turn. To get a precision of 1µm set the user unit movement = 13570, and motor counts = 524 288.

6.7 Allowed combinations of servo motors and drives

A BSD servo motor can be used with a BSD servo drive having a higher power rating than the motor but it is recommended to use the motor with its equivalent drive power. The exception is the FC08 (800W) servo motor that should be used with the 1000W drive, L7NA010.

It is an absolute must to enter the correct motor ID. Ignoring this will either cause the motor to be damaged – if the drive think the connected motor has a higher power than the one actually used - or to under perform – if the ID for a too small motor has been entered.

The motor ID can be read on the label on the motor or found in this table: Motor types and ID´s.

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The encoder value is read from the motor using a serial communication interface. This means that a BSD motor can not be used with a drive from another manufacturer.

6.8 Combining the servo motor with a gearbox

A gearbox has many advantages. Simplified the gearbox torque will be the motor rated torque multiplied by the gearing, and the load inertia the motor must handle will drop from the actual load inertia divided by the square of the gearing.

An (ideal) example:

- a motor with a rated torque of 1 Nm connected to a 10:1 gearing (10 turns on the input shaft results in 1 turn on the output shaft) will deliver 1 x 10 = 10 Nm on the gearbox output shaft.
- a load inertia of 1 kgm² will drop to 1 / 10^2 = 0.01 kgm² on the motor side and probably making it much easier to achieve an acceptable inertia ratio between motor and load.

The drawback is an increased motor speed. An increased gearing will result in an increased motor speed. The maximum motor speed must be taken into account when selecting the gearing.

A gearbox also provides a more stable mechanical interface. This can be important if the shaft needs to handle a static force due to belt tension or similar.

6.8.1 Gearbox adapter plates

Servo motors do not have a standardized dimensions and flanges in the same way as standard induction motors following the IEC34-standard [1)].

This means that a servo motor cannot normally be connected directly to a gearbox, the shaft diameter, motor flange diameter and drill holes will not fit. To solve this an adapter plate must be used, with one side manufactured to fit the gearbox and one to fit the motor.

The adapter plate is included when ordering a gearbox, but the motor model must be specified when the order is placed.

Beijer Electronics can offer gearboxes from Wittenstein for a variety of applications. Contact Beijer Drive Systems for help with selection and calculation.

[1)] One exception is Mitsubishi and BSD motors where some models can be interchanged without any need for mechanical adaption, see Mechanical interface.

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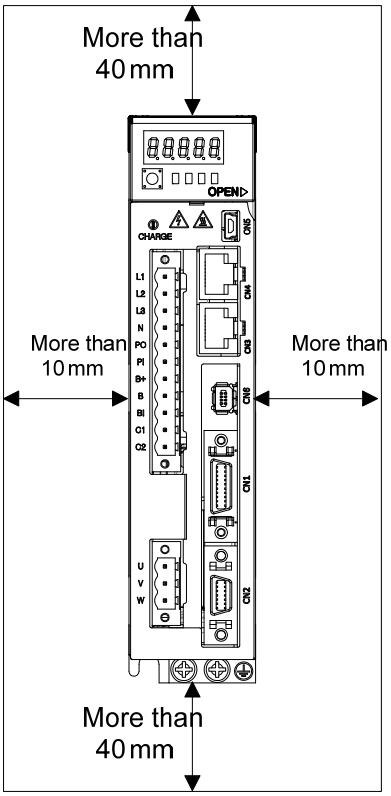
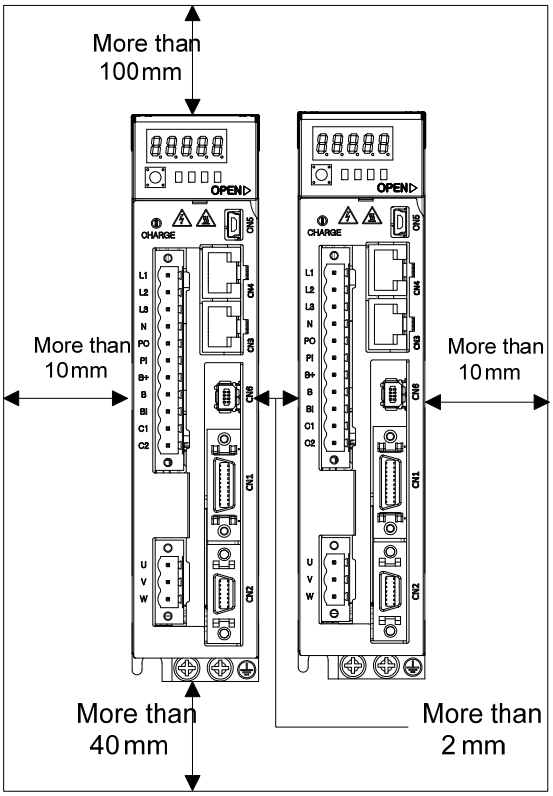
7 Installation of servo drive

The L7N servo drives have an IP20 protection. See Specifications servo drive regarding environmental restrictions.

7.1 Installation requirements regarding heat dissipation

Comply with the spacing specified in the following figures when installing the control panel.





⚠ Caution

- **Ensure that during installation the heat from the external regenerative resistor does not affect the drive.**
- **Ensure that the servo drive control panel is flat against the wall during installation.**
- **Ensure that the metal powder from drilling does not enter the drive when assembling the control panel.**
- **Ensure that oil, water, and metal dust do not enter the drive through gaps in the casing.**
- **Protect the control panel by spraying compressed air in areas which accumulate harmful gases or dust.**

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7.2 Fuses and wire dimensions

Name	L7NA001B	L7NA002B	L7NA004B	L7NA010B
Fuse	8 A			12 A
Main contactor	Customer supplied (11 A)			(18 A)
Wire	1.5 mm² / AWG 16			2.5 mm² / AWG 14

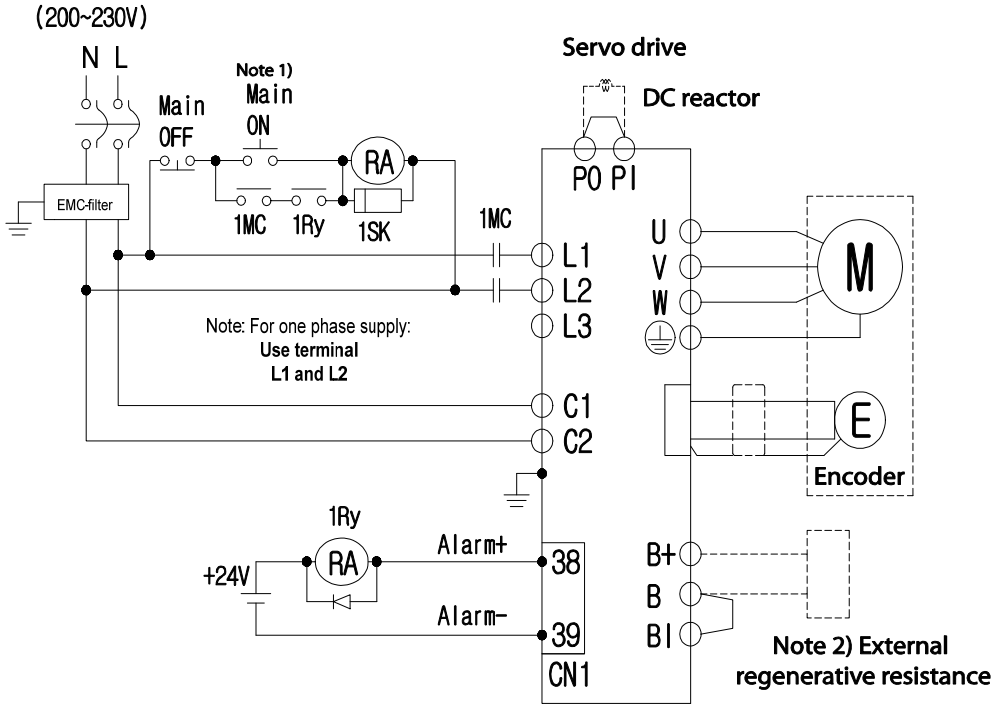
7.3 Power supply

7.3.1 L7N Drive Wiring Diagram [L7NA001B - L7NA010B]

The L7N amplifier can be connected to a one phase 200 - 230VAC power supply.

⚠ Caution
Do not connect 400VAC to the servo drive

7.3.1.1 One phase power supply



Note 1. It takes approximately one to two seconds to output an alarm signal after turning on the main power. Accordingly, press and hold the main power ON switch for at least two seconds.

Note 2. Check the B and BI short-circuit terminals and the L7NA001B-L7NA004B (50 W, 100 Ω), and L7NA010B (100 W, 40 Ω) regenerative resistors before use. If the regenerative capacity is high because of frequent acceleration and deceleration, open the short-circuit pins (B, BI) and connect an external regenerative resistor to B and B+.

Note 3. Remove approximately 7-10 mm of the sheathing from the cables for the main circuit power and attach crimp terminals. (Refer to Section 3.2.2, "Power Circuit Electrical Components.")

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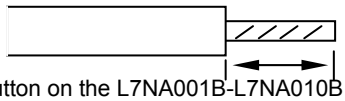

Note 4. Press the button on the L7NA001B-L7NA010B drive terminal to attach or remove wires to the main circuit power unit.

7.4 EMC-filter

Name	L7NA001B	L7NA002B	L7NA004B	L7NA010B
EMC Filter (EMC/NF)	BSD-B010LBEIE (10A) / or -B030NBDCE (30A)			

The EMC-filters are installed as stand alone filters beside the servo drive(s). All filters are intended for 3 x 230VAC. For one phase installations connect main L1 and N to L1 and L2 on the filter.

⚠ Caution
Do not connect 400VAC to the EMC filter

7.5 Regenerative brake resistors

7.5.1 Internal brake resistors

Name	L7NA001B	L7NA002B	L7NA004B	L7NA010B
Regenerative resistor (Built in)	50 W 100 Ω			100 W 40 Ω

The servo drives have built brake resistors for handling of regenerative energy. If the energy is higher than the allowed load it is possible to use an external brake resistor.

7.5.2 External brake resistors

Name	L7NA001B	L7NA002B	L7NA004B	L7NA010B
Regenerative resistor	BSD-140R50 140 W, 50 Ω			BSD-300R30 300 W, 30 Ω

The external brake resistor is connected to B and B+ on the servo drive. Remove the jumper between B and BI.

If an external brake resistor is used the specifications must be entered, see Brake resistor.

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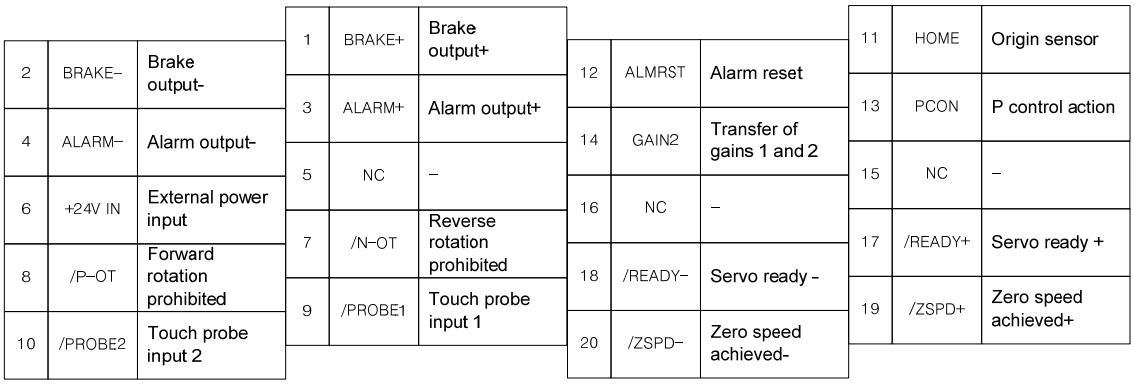
8 Control signals

All input and output signals are used with an external voltage level of 24VDC. Use a BSD-CN1□□A-cable to connect the I/O. The CN1-cable has one open end that can be connected to a terminal strip.

All control signals except PROBE1 and PROBE2 can be configured by the user.

8.1.1 Connector layout


2 BRAKE– Brake output-
4 ALARM– Alarm output-
6 +24V IN External power input
8 /P–OT Forward rotation prohibited
10 /PROBE2 Touch probe input 2
1 BRAKE+ Brake output+
3 ALARM+ Alarm output+
5 NC –
7 /N–OT Reverse rotation prohibited
9 /PROBE1 Touch probe input 1
12 ALMRST Alarm reset
14 GAIN2 Transfer of gains 1 and 2
16 NC –
18 /READY– Servo ready -
20 /ZSPD– Zero speed achieved-
11 HOME Origin sensor
13 PCON P control action
15 NC –
17 /READY+ Servo ready +
19 /ZSPD+ Zero speed achieved+

See CN1 I/O-cable in the *Specifications* chapter for details regarding the CN1-cable.

8.1.2 Input signals

Pin Number	Name	Details	Function
7	/N-OT	Reverse (CW) rotation prohibited	The actuator stops the servo motor to prevent it from moving beyond the motion range.
8	/P-OT	Forward (CCW) rotation prohibited	
11	HOME	Origin sensor	Connects the origin sensor to return to the origin.
12	ALMRST	Alarm reset	Deactivates the servo alarm.
13	PCON	P control action	When the contact is on, the speed control loop transfers the mode from PI control to P control.
14	GAIN2	Transfer of the gain 1 and gain 2	When gain 2 contact is ON, it transfers from gain 1 to gain 2.
9[Note 1)]	/PROBE1	Touch probe 1	The probe signal to rapidly store the position value.
10[Note 1)]	/PROBE2	Touch probe 2	

The input signals can be connected either as *sink* (0V = ON) or *source* (24V = ON). Maximum current per input is limited to 7mA. The signal state, NO – normally open, or NC – normally closed can be configured by the user.

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8.1.3 Output signals

Pin Number	Name	Details	Function
1	BRAKE+	Brake	Outputs signals to control the brake when the servo is turned on or off.
2	BRAKE-		
3	ALARM+	Alarm	Outputs a signal when an alarm occurs.
4	ALARM-		
17	/READY+	Servo Ready	This signal is output when the main power is established and the preparations for servo operation are complete.
18	/READY-		
19	/ZSPD+	Zero speed reached	Outputs a signal when the current speed drops below the zero speed.
20	/ZSPD-		
Allocated	INPOS	Location reached	Outputs a signal when the device reaches the specified location.
Allocated	INSPD	Speed reached	Outputs a signal when the device reaches the specified speed.
Allocated	WARN	Warning	Outputs warning signals.

The output signals have a maximum current of 150 mA. Loads with a higher current consumption may damage the output.

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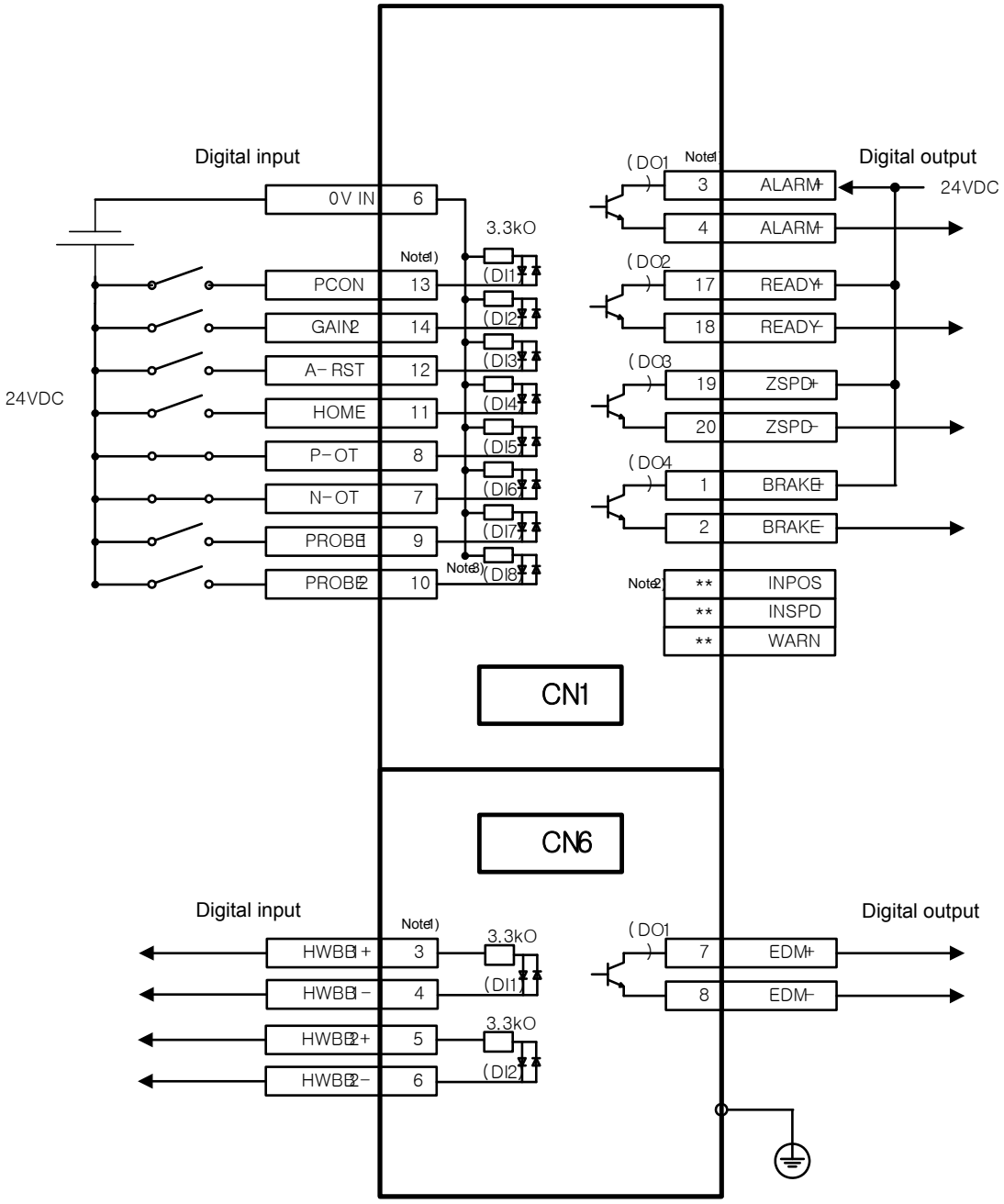
8.1.4 Wiring diagram



Note 1. The input signals (DI4~DI8), output signals (DO1~DO4) are the factory default signals.

Note 2. ** is unallocated signals. You can allocate those signals by setting I/O signal allocation. Refer to 6.3 I/O Contacts parameter setting for more information.

Note 3. Input signal DI7 and DI8 are always allocated as PROBE1, PROBE2 regardless of the input signal allocation setting.

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8.1.5 Safety

The STO (Safe Torque Off) function provides a safe way to stop the servo via two separate inputs (HWBB1 and HWBB2) without a power contactor. The status of the internal circuit can be supervised using the EDM-terminals.

8.1.5.1 Connector layout

8	EDM−	Pilot circuit state output-	6	/HWBB2+	Hard-wired base block signal input 2+	4	/HWBB1+	Hard-wired base block signal input 1+	2	NC	Note 1)
7	EDM+	Pilot circuit state output+	5	/HWBB2−	Hard-wired base block signal input 2-	3	/HWBB1−	Hard-wired base block signal input 1-	1	NC	Note 1)

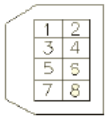
Note 1. Never use terminals 1 or 2. They are connected to the internal circuit.

8.1.5.2 Safety signals operation chart

Setting	/HWBB1	/HWBB2	EDM	STO State
1	OFF	OFF	ON	STO
2	ON	OFF	OFF	STO
3	OFF	ON	OFF	STO
4	ON	ON	OFF	Normal State

8.1.5.3 Safety bypass

If the safety is not used the CN6-connector must be blinded by using the jumper APCS-CN6JE.



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9 Installation of servo motor and motor cables

The L7N servo motors have an IP65 protection (excluding the axis penetration). See Specifications servo motor regarding environmental restrictions.

The motors are fully enclosed and self cooled. Make sure that there is sufficient ventilation around the motor. A BSD servo motor must always be connected to a BSD servo drive of the correct size. The motor ID must be entered in the drive before any operation is allowed.

⚠ Caution
Never connect a BSD servo motor directly to grid voltage.

Make sure that the motor phase power wires are connected in accordance with the wire labels. If the rotation direction of the motor needs to be changed this must be done by using the software, see Motor rotation direction.

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10 Basic parameters and initial setup

This section lists the basic parameters that must normally be set in the servo drive. Depending on the application other parameters may need to be set. Refer to the main manual for an in depth description of all parameters.

Most of these parameters are initiated when the servo drive control power is turned on. The parameter value must be written to the EEPROM-memory (flash) of the servo drive followed by a power cycle.

10.1 Motor ID

The motor ID can be read on the label on the motor or found in the table: Motor types and ID´s.

Index 0x2000		Motor ID					
Sub Index	Name	Data Type	Access	PDO Mapping	Setting Range	Initial value	Unit
0	Motor ID	UINT	RW	No	0 to 999	999	-

10.2 Encoder type

All BSD servo motors are equipped with a 19-bit serial type absolute encoder. Always set this parameter = 3.

Index 0x2001		Encoder Type					
Sub Index	Name	Data Type	Access	PDO Mapping	Setting Range	Initial value	Unit
0	Encoder Type	UINT	RW	No	0 to 5	0	-

Value	Encoder Type	Value	Encoder Type
0	-	1	Serial type encoder (-)
2	Serial type Abs encoder (12-bit)	3	Serial type Abs encoder (19-bit)
4	Serial type Abs encoder (20-bit)	5	Serial type Abs encoder (24-bit)

10.2.1 Multi turn (incremental or absolute encoder cable)

Set if it is an incremental or absolute application. This parameter should be set according to the selected encoder cable.

The encoder has a 16 bit multi turn memory. This stores the number of motor turns from the reference position (+/ 32768 turns). Note that CODESYS only supports a multi turn value of +/- 4096 turns.

Incremental encoder cable = single turn
Absolute encoder cable = multi turn

Index 0x200D		Basic Function Configuration					
Sub Index	Name	Data Type	Access	PDO Mapping	Setting Range	Initial value	Unit
0	Basic Function Configuration	UINT	RW	No	0b00 to 0b11	0b00	-

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Bit	function	Value (Hex)	Setting details
4	Set the multi-turn encoder	0	Use the multi-turn encoder as multi-turn
		1	Use the multi-turn encoder as single-turn

10.3 Motor rotation direction

When the motor is rotating *forward* (or positive*)* the encoder position will *increase*. The mechanical installation may require the rotation direction to be changed to avoid positioning to negative values.

Index 0x200D		Basic Function Configuration					
Sub Index	Name	Data Type	Access	PDO Mapping	Setting Range	Initial value	Unit
0	Basic Function Configuration	UINT	RW	No	0b00 to 0b11	0b00	-

Bit	function	Value (Hex)	Setting details
0	Sets the servo drive direction	0	CCW (Clockwise), CW (Counterclockwise)
		1	CW (Clockwise), CCW (Counterclockwise)

10.4 Homing

The default homing method is 0 = no homing (0x6098). The encoder value is set to the defined home position (0x607C, (DINT, user units)) immediately when the start homing bit is triggered. Refer to section 5.4, "Homing" in the main manual.

Index 0x6098		Homing Method					
Sub Index	Name	Data Type	Access	PDO Mapping	Setting Range	Initial value	Unit
0	Homing Method	SINT	RW	Yes	0 to 35	34	-

10.5 Brake resistor

If an external brake resistor is used the following parameters must be set according to the resistor specifications:

This specifies the resistance value for regenerative braking resistance. If it is set to 0, then it uses the default resistance capacity embedded in the drive.

Index 0x2007		Regenerative Resistor Value					
Sub Index	Name	Data Type	Access	PDO Mapping	Setting Range	Initial value	Unit
0	Regenerative Resistor Value	UINT	RW	No	0 to 1000	0	ohm

This specifies the current capacity for regenerative resistance. If it is set to 0, then it uses the default resistance capacity embedded in the drive.

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Index 0x2008		Regenerative Resistor Capacity					
Sub Index	**Name**	**Data Type**	**Access**	**PDO Mapping**	**Setting Range**	**Initial value**	**Unit**
0	Regenerative Resistor Capacity	UINT	RW	No	0 to 30000	0	Watt

10.6 Motor brake

Index 0x200B		PWM Off Delay					
Sub Index	**Name**	**Data Type**	**Access**	**PDO Mapping**	**Setting Range**	**Initial value**	**Unit**
0	PWM Off Delay	UINT	RW	No	0 to 1000	10	Ms

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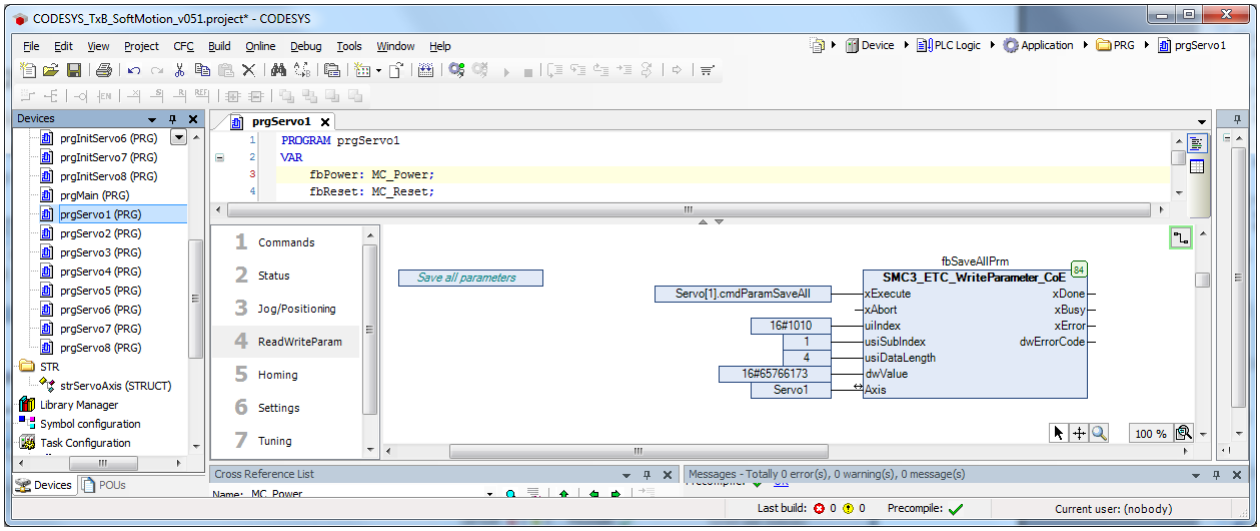
11 Accessing parameters from CODESYS

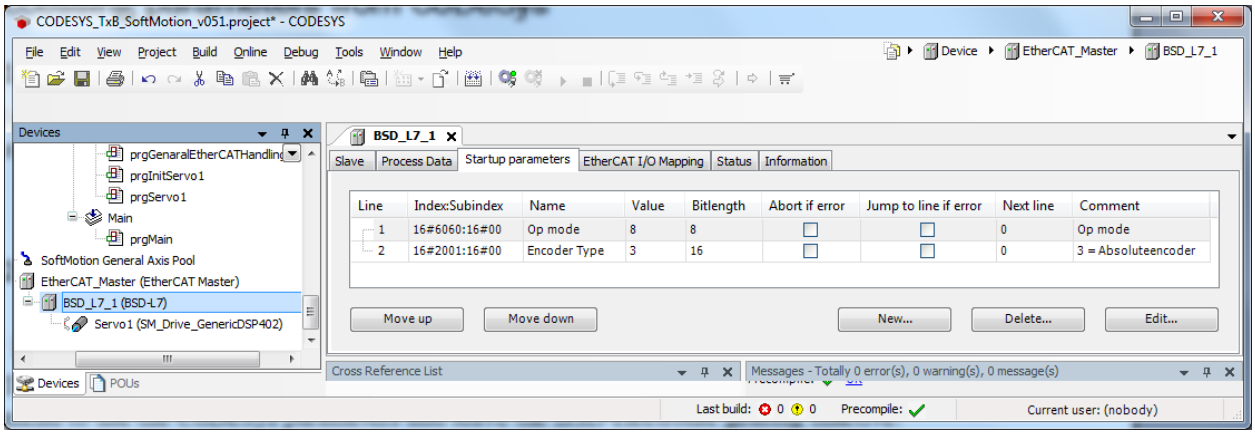
11.1.1 Save to servo drive EEPROM

CODESYS can be used to store parameters to the EEPROM-memory (flash). Note that the changes will not take effect until the next control power up on the servo drive.



11.1.2 Parameter download at start up

CODESYS can download a set of parameters automatically at each power up. Note that these values are not written to the EEPROM. Also note that a large amount of values will increase the start up time of the application,



11.2 Electronic gearing

Note: The electronic gearing can be defined both in the BSD drive and in CODESYS. We recommend to use the CODESYS parameters and leave the BSD electronic gearing inactive.

The electronic gearbox is defined in CODESYS by double clicking on the servo motor in the EtherCAT node´s list.

Set the relation between the servo motor and the mechanical solution in three steps (the values in the description below relates to the settings on the screen shot):

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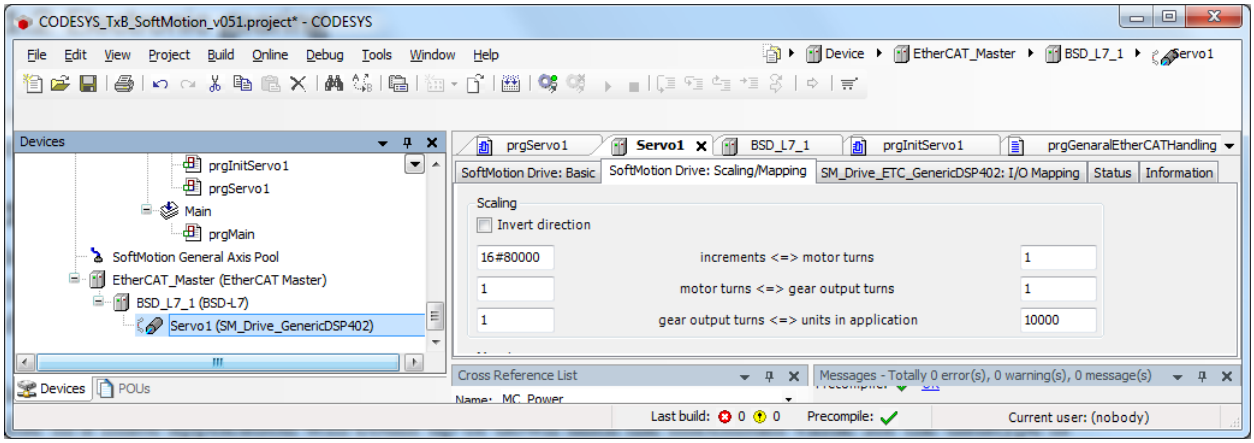
1. Relation between motor counts and motor turns (counts / turn) =
   524 288 counts (or 16#80000 (hexadecimal)) = 1 motor turn

2. Gearing. Set the number of motor turns per gear output turns. This does not have to be a physical gearbox, all equipment that creates a gearing must be specified here:
   1 motor turn = 1 output turn

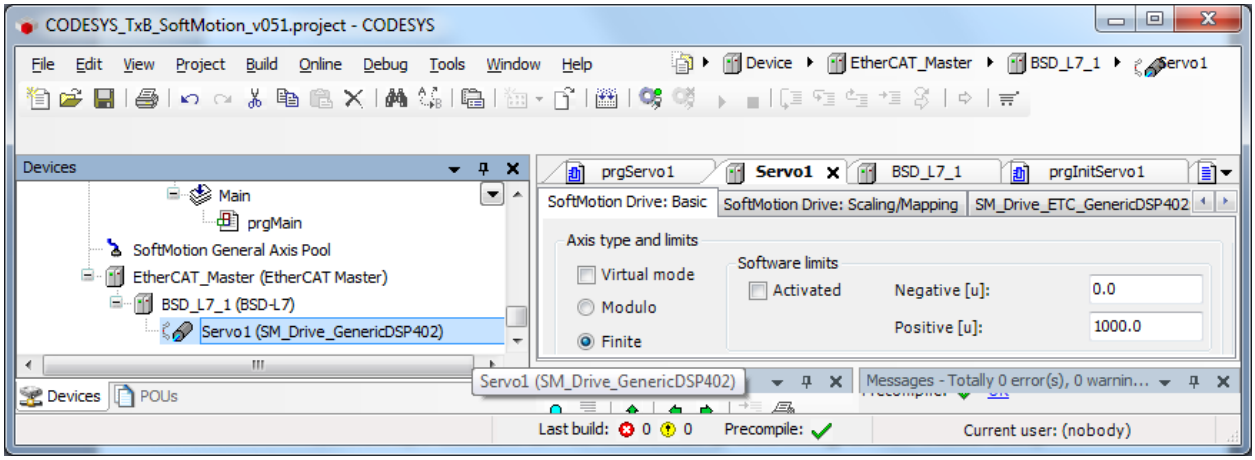
3. Mechanical movement per motor turn in application units:
   1 output turn = 10000 user units (= 10 mm if user units is selected as µm)


CODESYS_TxB_SoftMotion_v051.project* - CODESYS
File Edit View Project Build Online Debug Tools Window Help
Device EtherCAT_Master BSD_L7_1 Servo1
Devices
prgInitServo1
prgServo1
Main
prgMain
SoftMotion General Axis Pool
EtherCAT_Master (EtherCAT Master)
BSD_L7_1 (BSD-L7)
Servo1 (SM_Drive_GenericDSP402)
prgServo1 Servo1 BSD_L7_1 prgInitServo1 prgGenaralEtherCATHandling
SoftMotion Drive: Basic SoftMotion Drive: Scaling/Mapping SM_Drive_ETC_GenericDSP402: I/O Mapping Status Information
Scaling
Invert direction
16#80000 increments <=> motor turns 1
1 motor turns <=> gear output turns 1
1 gear output turns <=> units in application 10000
Cross Reference List
Messages - Totally 0 error(s), 0 warning(s), 0 message(s)
Devices POUs
Last build: 0 0 Precompile: Current user: (nobody)

11.3 Software limits and modulo/finite

Note: Software limits can be defined both in the BSD drive and in CODESYS. We recommend to use the CODESYS parameters and leave the BSD soft limits as inactive.

The software limits are defined in CODESYS by double clicking on the servo motor in the EtherCAT node´s list. Set the positive and negative software limit in user units and check if the software limits should be active or not. The software limits can also be accessed via the generic driver.



The same screen is used when selecting between a modulo or finite application. The position value in a finite application will count up or down until the maximum value for the data type is reached, for a double integer the position limits will be +/- 2147483648 counts.

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A modulo application will have a defined value where the position value resets to zero, for example a turn table scaled in degrees can set its modulo value to 360.0. In forward direction the position value will increase up to 359.9 degrees and then it will be reset to zero. This allows for simple positioning in angular systems or applications that always rotates in the same direction.

Software limits cannot be used in a modulo application.

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12 Specifications

12.1 Specifications servo drives

Item \ Name			L7NA 001B	L7NA 002B	L7NA 004B	L7NA 010B
Input power	Main power		1 or 3-phase AC 200-230 V (-15-10[%]), 50-60 [Hz]			
	Control power		Single-phase AC 200-230 V (-15-10[%]), 50-60 [Hz]			
Rated current (A) (three phase)			1.4	1.7	3.0	6.75
Peak current (A) (three phase)			4.2	5.1	9.0	20.25
Rated current (A) (one phase)			2.2	2.7	4.4	9.4
Encoder Type			Serial 19 bit			
Control performance		Speed control range	Maximum 1: 5000			
		Frequency response	Maximum 1 kHz or more (when the 19-bit serial encoder is applied)			
		Speed change rate	±0.01% or lower (when the load changes between 0 and 100%) ±0.1% or less (temperature of 25°C (±10))			
		Torque control repetition accuracy	Within ±1%			
Supported drive modes (CiA402)			Profile Position Mode Profile Velocity Mode Profile Torque Mode Interpolated Position Mode Cyclic Synchronous Position Mode Cyclic Synchronous Velocity Mode Cyclic Synchronous Torque Mode Homing Mode			
Digital input/output		Digital input	A total of 6 input channels (allocable) PCON, GAIN2, ALMRST, HOME, P-OT, N-OT You can selectively allocate a total of 6 functions. You can set the positive/negative logic of the selected signal.			
		Touch probe input	There are 2 input channels. Provides rising and falling edge detection functions for each channel.			
		Digital output	A total of 4 channels (allocable) ALARM, READY, ZSPD, BRAKE, INPOS, INSPD, WARN You can selectively allocate a total of 7 output types. You can set the positive/negative logic of the selected signal.			
Additional communication		USB	You can upload/download programs through the USB connection.			
Built-in functions		Dynamic Braking	Standard built-in brake (activated when the servo alarm goes off or when the servo is off).			

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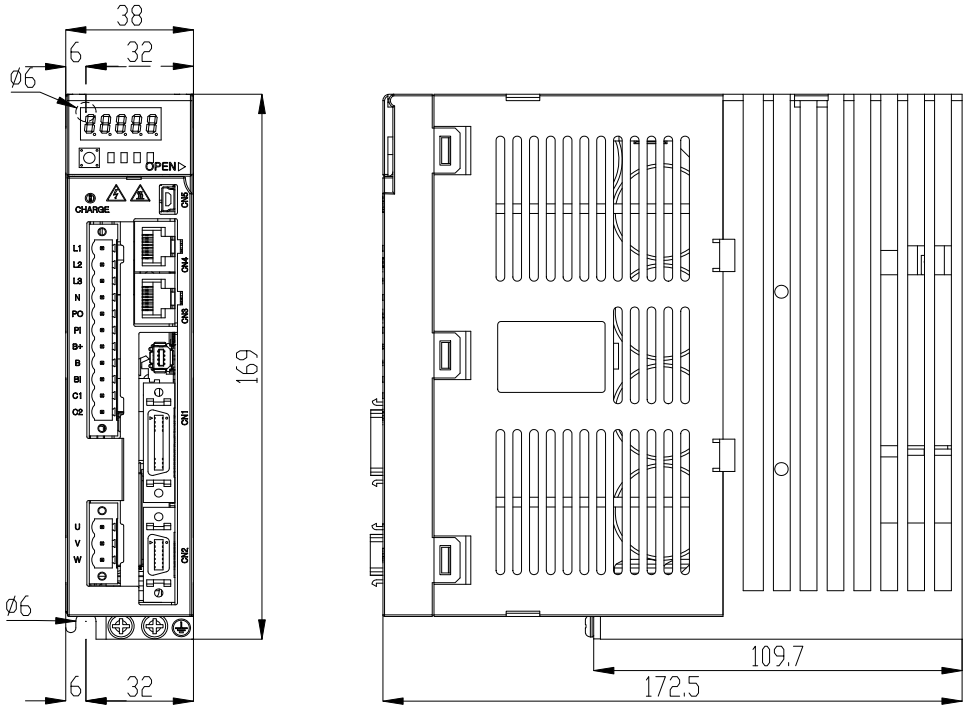
Item	Name	L7NA 001B	L7NA 002B	L7NA 004B	L7NA 010B
	Regenerative Braking	Both the default built-in brake and an externally installed brake are possible.			
	Display Function	Seven segments (5 DIGIT)			
	Self-setting Function	The [Mode] key changes the content displayed in the 7 segments.			
	Additional Function	Auto gain tuning function			
	Protection Function	Overcurrent, overload, overvoltage, low voltage, main power input error, control power input error, overspeed, motor cable, heating error (power module heating, drive temperature error), encoder error, excessive regeneration, sensor error, communication error			
Environment	Temperature	0 ~ 50°C			
	Humidity	90% RH or less (no condensation)			
	Environment	Indoors in an area free from corrosive or combustible gases, liquids, or dust.			

12.2 Physical dimensions servo drives

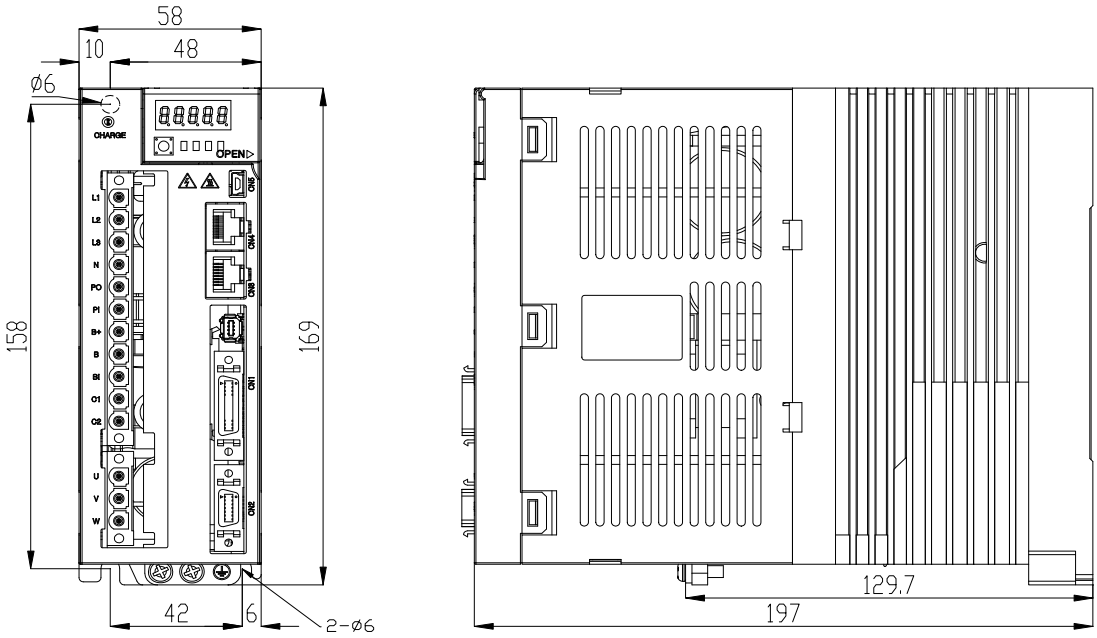
12.2.1L7NA001B - L7NA004



★Weight: 1kg

Normal.dot, 070221

12.2.2L7NA010B



★Weight: 1.5 kg (including the cooling fan)

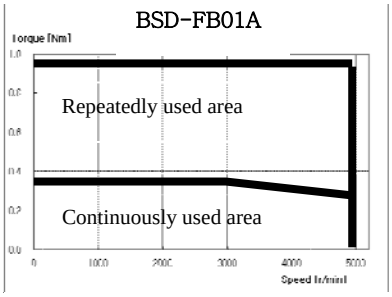
12.3 Specifications servo motors

Servo Motor Type (BSD-□□□□□)		FB01A	FB02A	FB04A	FC08A
Applicable Drive (BSD-L7NA□□)		L7NA001	L7NA002	L7NA004	L7NA010
Rated Output	kW	0.1	0.2	0.4	0.8
Rated torque	N·m	0.32	0.64	1.27	2.39
Maximum instantaneous torque	N·m	0.96	1.91	3.82	7.16
Rated rotation speed	RPM	3000			
Maximum rotation speed	RPM	5000			
Inertia moment	kg·m2x10-4	0.09	0.15	0.25	1.25
Permitted load inertia		Motor inertia x20			Motor inertia x15
Rated power rate	kW/s	11.38	27.95	65.90	45.78
Speed and position detector	Standard	Serial type 19 bit			
	Option	None			
Specifications and features	Protection method	Fully enclosed·self-cooling IP65 (excluding axis penetration)			
	Time rating	Continuous			
	Ambient temperature	0-40°C			
	Ambient humidity	20-80% RH (no condensation)			
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas			
	Anti-vibration	Vibration acceleration of 49 m/s2 (5G)			
Weight	kg	0.7	0.9	1.3	2.7

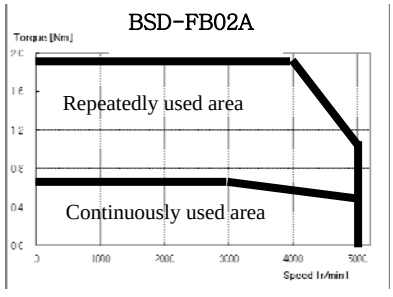
Normal.dot, 070221

♦Rotation Speed - Torque Characteristics♦

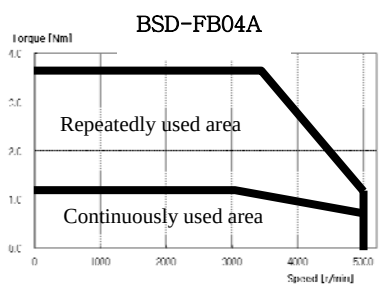
BSD-FB01A



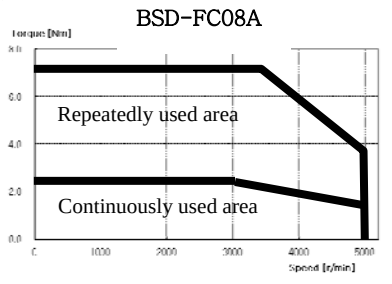
BSD-FB02A



BSD-FB04A



BSD-FC08A



12.4 Motor types and ID´s

Model Name	ID	Watt	Notes
FB01A	711	100	
FB02A	712	200	
FB04A	713	400	
FC08A	723	800	

Model Name	ID	Watt	Notes

Normal.dot, 070221

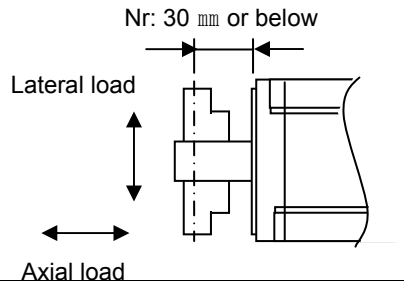
12.5 Physical dimensions servo motors

12.5.1Mechanical interface

All BSD motors are delivered with a keyed shaft and a removable key. The motor shaft and flange dimensions are equal the Mitsubishi motors of the HF-KP and HF-HG-series, see table below. This means that they can be interchanged without any mechanical adaption.

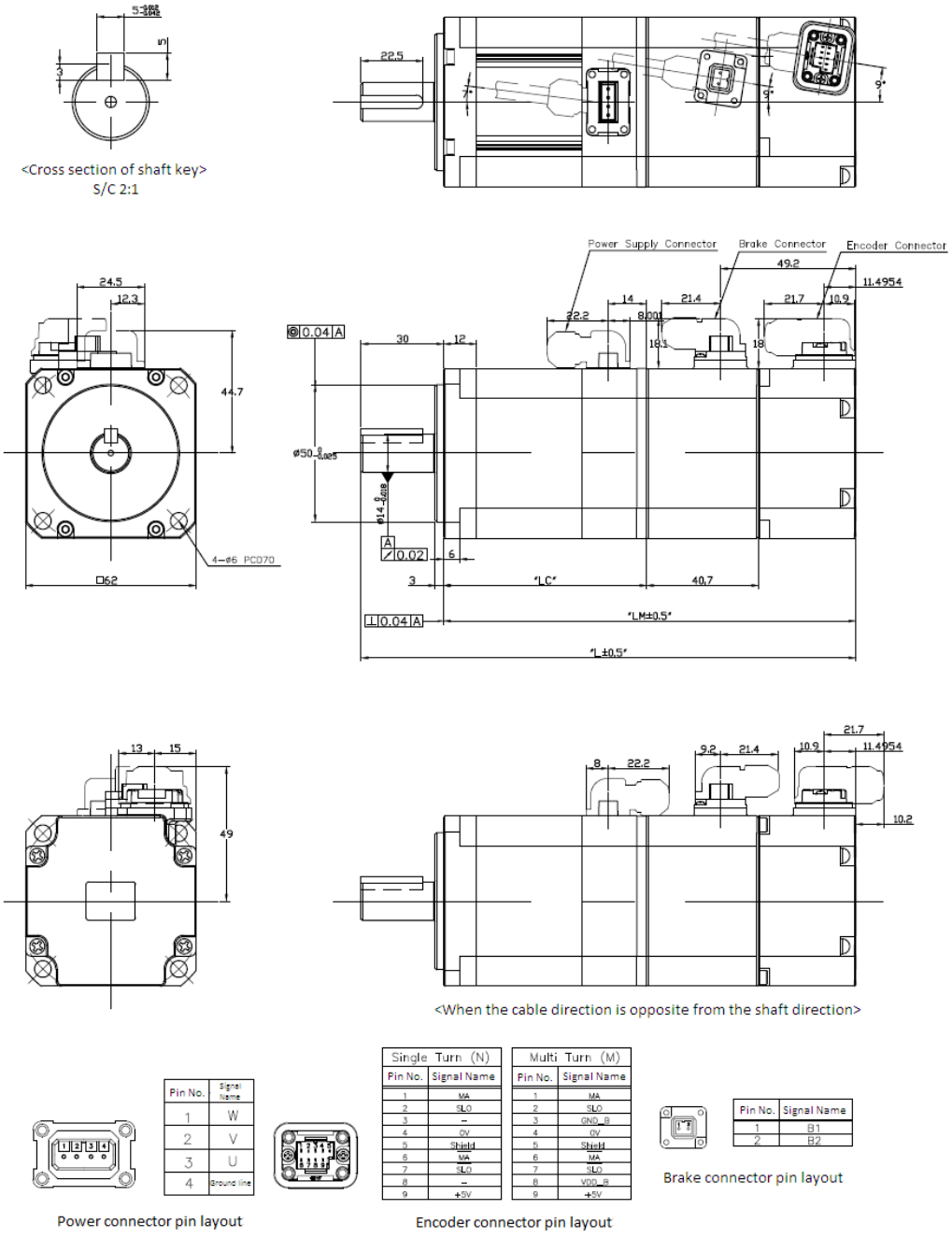
BSD	Mitsubishi
No match	HF-KP13(B), HG-KR13(B)
FB01AMK(2), FB02AMK(2), FB04AMK(2)	HF-KP23(B), HF-KP43(B), HG-KR23(B), HG-KR43(B)
FC08AMK(2)	HF-KP73(B), HG-KR73(B)

Note that there is a limitation on the allowed axial and radial force on the motor shafts. This must especially be controlled in toothed belt (pulley) applications where the belt tension may cause a high radial force.

Flange	Lateral Load		Axial Load		Notes
	N	kgf	N	kgf	
60	206	21	69	7	
80	255	26	98	10	

Normal.dot, 070221

12.5.2FB Series : BSD-FB01A, BSD-FB02A, BSD-FB04A



Pin No.	Signal Name
1	W
2	V
3	U
4	Ground line

Power connector pin layout

Single Turn (N)	
Pin No.	Signal Name
1	MA
2	SLO
3	–
4	0V
5	Shield
6	MA
7	SLO
8	–
9	+5V

Multi Turn (M)	
Pin No.	Signal Name
1	MA
2	SLO
3	GND_B
4	0V
5	Shield
6	MA
7	SLO
8	VDD_B
9	+5V

Encoder connector pin layout

Pin No.	Signal Name
1	B1
2	B2

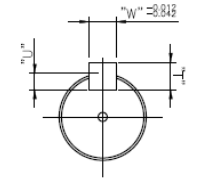
Brake connector pin layout

Name	External Dimensions			Weight(kg)
	L	LM	LC	
FB01A	109(149.2)	79(119.2)	43.5(43)	0.72(1.3)
FB02A	120(160.2)	90(130.2)	54.5(54)	0.94(1.49)
FB04A	140(180.2)	110(150.2)	74.5(74)	1.32(1.87)

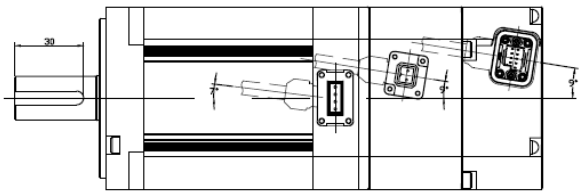
Note 1. The sizes in parentheses apply when attached to the brakes.

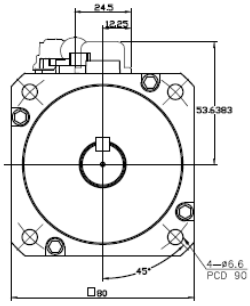
Normal.dot, 070221

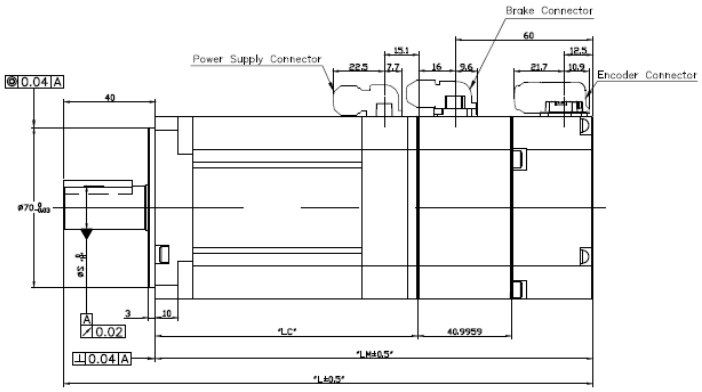
12.5.3FC Series: BSD-FC08A

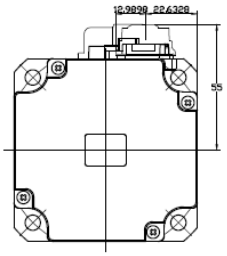


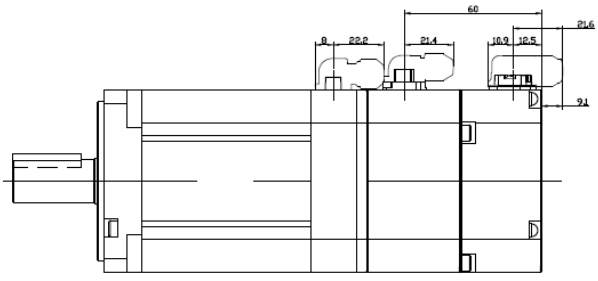
<Cross section of shaft key>
S/C 2:1



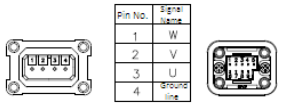






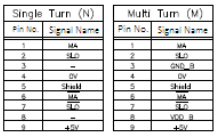


<When the cable direction is opposite from the shaft direction>



Pin No.	Signal Name
1	W
2	V
3	U
4	Ground line

Power connector pin layout



Single Turn (N)	
Pin No.	Signal Name
1	MA
2	MA\
3	–
4	5V
5	Shield
6	MA
7	MA\
8	–
9	+5V

Multi Turn (M)	
Pin No.	Signal Name
1	MA
2	MA\
3	GND_B
4	5V
5	Shield
6	MA
7	MA\
8	VDD_B
9	+5V

Encoder connector pin layout

Pin No.	Signal Name
1	B1
2	B2

Brake connector pin layout

Name	External Dimensions				Weight(kg)
	L	LM	LC	S	
FC08A	172.5(213)	132.5(173)	97(96.5)	19	2.72(3.76)

Note 1. The sizes in parentheses apply when attached to the brakes.

Normal.dot, 070221

12.5.4Motor brake specification

Applicable Motor Series	BSD-FB	BSD-FC
Purpose	Maintenance of stop(refer to Note 2 below)	
Input voltage (V)	DC24V	
Static friction torque (N•m)	1.47	3.23
Capacity (W)	6.5	9
Coil resistance (Ω)	89	64
Rated current (A)	0.27	0.38
Braking mechanism	Spring brake	
Insulation grade	Grade F	

Note 1. Electric brakes are designed to maintain a stop. Never use them for absolute braking.

12.6 Specifications EMC-filters

Use a EMC-filter to reduce electronic disturbances and harmonics generated by the servo drive from reaching other parts of the equipment.

The EMC-filters are intended for use with one or three phase 230VAC. If used with a one phase supply connect grid L1 and Neutral to L1 and L2 on the EMC-filter.

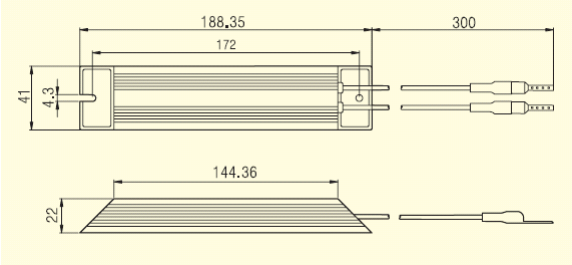
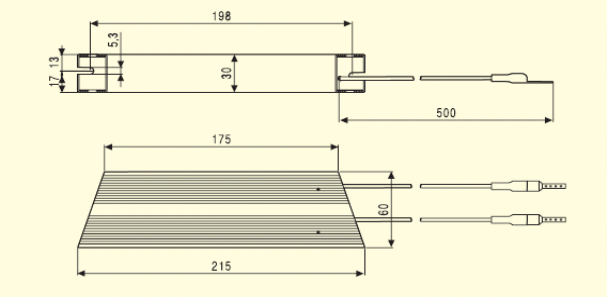
Connect the EMC-filter in serial between the grid supply and the power terminals on the servo drive (L1, L2 (L3), C1, C2).

One EMC-filter can be used to supply more than one amplifier. Make sure that the total amplifier current consumption does not exceed the rated current of the EMC-filter, see Specifications servo drives. Note that the rated current is higher when using a one phase supply.

Category	Product Name	Name	Applicable Drive	Specifications
EMC	EMC-filter	BSD-TB6-B010LBEIE	L7NA001B L7NA002B L7NA004B L7NA0010B	3x230VAC, 10A
EMC	EMC-filter	BSD-TB6-B030NBDCE	L7NA001B L7NA002B L7NA004B L7NA0010B	3x230VAC, 30A

Normal.dot, 070221

12.7 Specifications brake resistors

Category	Product Name	Name	Applicable Drive	Specifications
Resistance	Brake resistor	BSD-140R50	L7NA001B L7NA002B L7NA004B	
Resistance	Brake resistor	BSD-300R30	L7NA010B	

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12.8 Specifications cables

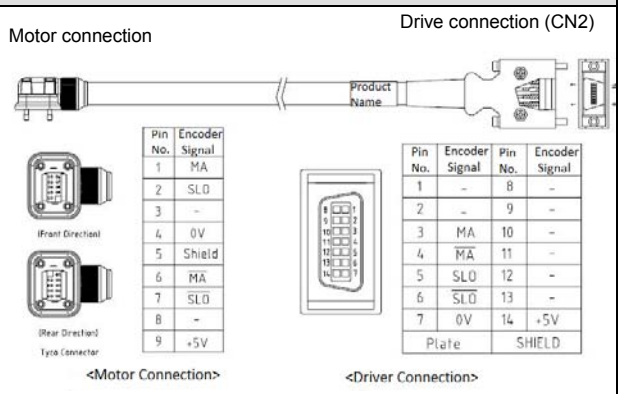
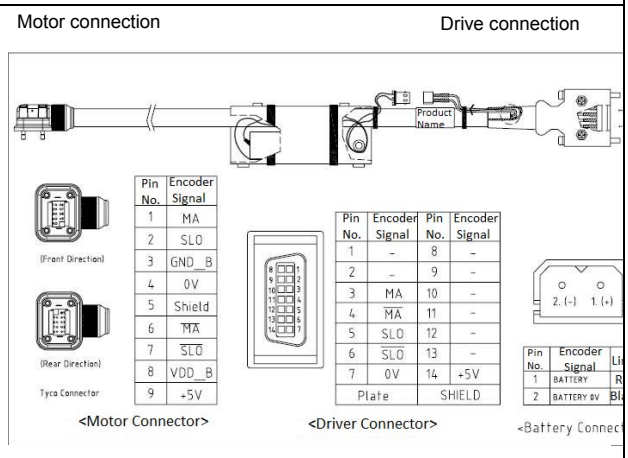
12.8.1Cable types and flexibility

All motor cables are connected with ready made connectors at the motor end. All connectors are pointing towards the motor shaft. The encoder cable has connectors in both end and the length cannot be modified.

The specified minimum bending radius for each cable must be met, see table below:

Type	Denomination	Outer diameter (mm)	Bending radius (mm x diameter)
Encoder cable	BSD-E□□□ES(1)	6.7	10
Motor cable	BSD-P□□□FS	6.1	10
Brake cable	BSD-B□□□QS	5.1	7.5

12.8.2Encoder cables

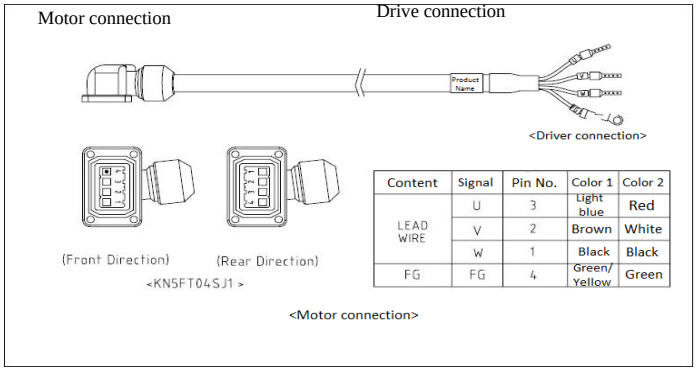
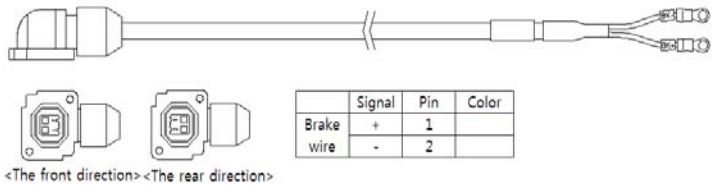
Category	Product Name	Name (Note 1)	Applicable Motors	Specifications
Incremental	Encoder cable	BSD-E□□□ES	All models of BSD-FB and BSD-FC Series	
Absolute	Multi turn encoder Cable	BSD-E□□□ES1	All models of BSD-FB and BSD-FC Series	

Note 1. The □□□ in the name indicates the type and length of each cable. Refer to the table below.

Cable length (m)	3	5	10	20
Robot cable	F03	F05	F10	F20

Normal.dot, 070221

12.8.3Motor power and brake cables

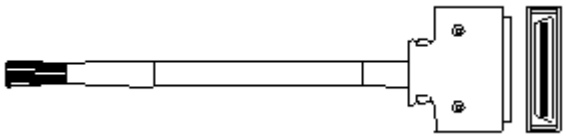
Category	Product Name	Name (Note 1)	Applicable Motors	Specifications
Power	Power cable	BSD-P□□□FS	All models of BSD-FB and BSD-FC Series	 Content / Signal / Pin No. / Color 1 / Color 2 LEAD WIRE: U / 3 / Light blue / Red V / 2 / Brown / White W / 1 / Black / Black FG / FG / 4 / Green/Yellow / Green
Brake	Brake cable	BSD-B□□□QS	All models of BSD-FB and BSD-FC Series	 Signal / Pin / Color Brake wire: + / 1 / - / 2 /

Note 1. The □□□ in the name indicates the type and length of each cable. Refer to the table below.

Cable length (m)	3	5	10	20
Robot cable	F03	F05	F10	F20

Normal.dot, 070221

12.8.4CN1 I/O-cables

Category	Product Name	Name (Note 1)	Applicable Drive	Specifications
For signalling	CN1 Cable	BSD-CN1□□A	L7N Series	

Note 1. The □□ in the name indicates the length of each cable. Refer to the table below.

Cable length (m)	1	2	3	5
Indication	01	02	03	05

12.8.4.1 CN1 I/O-cable description and color coding

The open end of the BSD-CN1□□A-cable is arranged according to the table below. The cable wires is coded with colored dots arranged in groups.

Correspon-ding Terminal	Pair	Color	Dot Color	Nr of grouped dots	Function
1	1	Orange	Black	1	BRAKE+
2	1	Orange	Red	1	BRAKE-
3	2	Yellow	Black	1	ALARM+
4	2	Yellow	Red	1	ALARM-
6	-	White	Red	1	24V
7	3	Grey	Black	1	CWL
8	3	Grey	Red	1	CCWL
9	4	Pink	Black	1	PROBE1
10	4	Pink	Red	1	PROBE2
11	5	Orange	Black	2	HOME
12	5	Orange	Red	2	ALMRST
13	6	Yellow	Black	2	DI1
14	6	Yellow	Red	2	DI2
17	7	Grey	Black	2	RDY+
18	7	Grey	Red	2	RDY-
19	8	Pink	Black	2	DO1+
20	8	Pink	Red	2	DO1-

12.8.5Safety cables

Category	Product Name	Name (Note 1)	Applicable Drive	Specifications
Safety	CN6 Cable	APCS-STO□□A	L7N Series	Safety cable with CN6 connector and one open end

Note 1. The □□ in the name indicates the length of each cable. Refer to the table below.

Cable length (m)	0.3	1	3
Indication	03	10	30

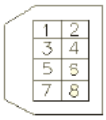
Normal.dot, 070221

12.8.5.1 CN6 Safety-cable description and color coding

The open end of the APCS-STO□□A-cable is arranged according to the table below.

Corresponding Terminal	Color	Function
3	Black	HWBB1+
4	Red	HWBB1-
5	Yellow	HWBB2+
6	Orange	HWBB2-
7	Blue	EDM+
8	Green	EDM-

12.8.60ptional connectors and accessories

Category	Product Name	Name (Note 1)	Applicable Drive	Specifications
CN2	CN2 Connector	APC-CNNAE	L7N Series	Encoder cable connector, solder
CN6	CN6 Connector Dummy/Blind Plug	APCS-CN6J	L7N Series	 Included with drive. Connected pins: 1 – 4, 3 – 6, 2 – 5

Normal.dot, 070221

13 Trouble shooting

13.1 Alarm codes

If an alarm occurs, then the malfunction signal output contact (ALARM) goes off and the dynamic brake stops the motor.

Alarm Code	Name	Details	What to check
AL-10	IPM Fault	Overcurrent (H/W)	Check for incorrect wiring in the drive output and encoder. Check the motor ID, drive ID, and encoder settings. Determine whether there is a conflict or binding in the equipment.
AL-11	IPM temperature	IPM overheat	Check for incorrect wiring in the drive output and encoder. Check the motor ID, drive ID, and encoder settings. Determine whether there is a conflict or binding in the equipment.
AL-14	Overcurrent	Overcurrent (S/W)	Check for incorrect wiring in the drive output and encoder. Check the motor ID, drive ID, and encoder settings. Determine whether there is a conflict or binding in the equipment.
AL-15	Current offset	Abnormal current offset	Check whether the U-phase current offset [0x2614] and V-phase current offset [0x2615] are 5% of the rated current or higher. Replace the drive.
AL-16	Overcurrent (/CL)	Overcurrent (H/W)	Check for incorrect wiring in the drive output and encoder. Check the motor ID, drive ID, and encoder settings. Determine whether there is a conflict or binding in the equipment.
AL-21	Continuous overload	Continuous overload	Determine whether there is a conflict or binding in the equipment. Check the load and the condition of the brake. Check for incorrect wiring in the drive output and encoder. Check the motor ID and encoder settings.
AL-22	Room temperature	Drive overheat	Check the temperature inside the drive [St-19]. Install a cooling fan and check the load.
AL-23	Regen. Overload	Regenerative overload	Check the input voltage, regenerative braking resistance, and wiring. Replace the drive.
AL-24	Motor cable open	Motor disconnection	Check the wiring of the motor.
AL-30	Encoder comm.	Serial encoder communication error	Check for incorrect wiring of the serial encoder.

Normal.dot, 070221

Alarm Code	Name	Details	What to check
AL-31	Encoder cable open	Encoder cable disconnection	Check whether the encoder cable is disconnected.
AL-32	Encoder data error	Encoder data error	Check the encoder settings and wiring.
AL-33	Motor setting error	Motor ID setting error	Replace the encoder.
AL-35	Low Battery Error	Low voltage error	Low voltage of Back Up battery, when Absolute encoder is applied. ※Reset the operation after changing battery. (Applied after S/W Ver 1.3)
AL-40	Under voltage	Low voltage	Check input voltage and power unit wiring.
AL-41	Overvoltage	Overvoltage	Check the input voltage and wiring. Check the braking resistance for damage. Check for excessive regenerative operation. Check the regenerative resistance.
AL-42	RST power fail	Main power failure	Check the power unit wiring and power supply.
AL-43	Control power fail	Control power failure	Check the power unit wiring and power supply.
AL-50	Over speed limit	Overspeed	Check the encoder, encoder settings, encoder wiring, gain settings, motor wiring, motor ID, electric gear ratio, and speed command scale.
AL-51	Position following	Excessive position error	Check the Following Error Window [0x6065], wiring and limit contacts, gain setting values, encoder settings, and electric gear ratio settings. Check the load on the equipment and whether there is binding on the equipment.
AL-54	Encoder Position Difference	Difference between 2 encoders	Check value of difference between internal and external encoder or external encoder when Full-Closed control
AL-65	EtherCAT Comm.Err 1	EtherCAT communication malfunction	Check the CN3 and CN4 connectors and the EtherCAT communication cable. Replace the drive.
AL-66	EtherCAT Comm.Err 2		
AL-67	EtherCAT Comm.Err 3		
AL-71	Invalid factory setting	Invalid factory settings	Restore the default parameters [0x1011].
AL-72	GPIO setting	Output contact point setting error	Restore the default parameters [0x1011].

Normal.dot, 070221

13.2 Warning codes

A warning code appears in the current operation status [St-00] if the servo drive is operating abnormally. Check the warning code to determine what you need to inspect. For EMG [W-80] errors, however, the dynamic brake stops the motor.

Warning State (CODE)	Name	Details and causes	What to check
	RST_PFAIL	Main power phase loss	The equipment does not receive main power when the handling method for the main power phase loss [0x2003] is set to 1.
	LOW_BATT	Low battery	The output voltage of the encoder backup battery is insufficient when applying an absolute encoder.
	OV_TCMD	Excessive Torque Command	You have exceeded the maximum number of torque commands.
	OV_VCMD	Excessive speed command	You have exceeded the maximum number of speed commands.
	OV_LOAD	Overload warning	The accumulated overload has reached the overload warning level [0x200A].
	SETUP	Capacity settings	The electric current capacity of the motor is larger than that of the drive.
	UD_VTG	Low voltage warning	The DC-link voltage is 190V or below when second bit of [0x2003] is set to 1.
	EMG	EMG warning	Check the emergency stop contact signal and the external 24 V power.
	STO connection error	STO connection error	Check the operation and connection setting.
	CCW Limit	CCW Limit on setting	Check the setting and point of contact.
	CW Limit	CW Limit on setting	Check the setting and point of contact.

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